

Segmentation of Unstructured Newspaper Documents

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Abstract— Document layout analysis is one of the important steps in automated document recognition systems. In Document layout analysis, meaningful information is retrieved from document images by identifying, categorizing and labeling the semantics of text blocks from the document images. In this paper, we present simple top-down approach for document page segmentation. We have tested the proposed method on unstructured documents like newspaper which is having complex structures having no fixed structure. Newspaper also has multiple titles and multiple columns. In the proposed method, white gap area which separates titles, columns of text, line of text and words in lines have been identified to separate document into various segments. The proposed algorithm has been successfully implemented and applied over a large number of Indian newspapers and the results have been evaluated by number of blocks detected and taking their correct ordering information into account.

Keywords— Document Layout Analysis, data extraction, document page segmentation, unstructured document.

I. INTRODUCTION

Document image segmentation is an important step in a document understanding system. The main aim of a page segmentation process is to separate a document image into its regions such as text, tables, images, drawings and headings. There are three different methods for page segmentation and layout analysis viz., a) Top-down, b) Bottom-up and c) Hybrid methods [11]. Top-down method start by detecting the highest level of structures such as columns and graphics, and proceed by successive splitting until they reach the bottom layer for small scale features like individual characters. In top-down methods, a priori knowledge about the page layout is necessary. Bottom-up

methods start with the smallest elements such as pixels, merging them recursively in connected components or regions of characters and words, and then in larger structures such as columns. They are more flexible but errors are accumulated in every iteration. It makes use of methods like connected component analysis [12], run-length smoothing [13], region-growing methods [14], and neural networks [15]. Most of these methods are computationally expensive Many other methods are there that do not fit into top-down and bottom-up categories and therefore are called hybrid methods. Among these methods are texture-based [16] and Gabor filter [17]. Some work has done based on pyramid segmentation.

II. LITERATURE REVIEW

In the method [2] for segmentation and classification of digital documents using run length smearing approach. A linear adaptive classification scheme used to discriminates text regions from others. [3] proposed X-Y cut page segmentation approach based on top down approach. In this method entire document is considered as root and respective decomposed rectangular regions as leaf nodes. Horizontal and vertical projection profiles of foreground pixels are used for decomposition. [4] Proposed a method for segmentation of document using white space analysis method. In [4] segmentation technique is independent of any threshold values in proposed method. In these method white spaces runs greater than one fifth of the page are identified in both horizontal and vertical directions. Thinning algorithm is used for thinning of lines. In this way a mesh is formed by combining lines in both horizontal and vertical directions. [5, 6] proposed bottom-up approaches for page segmentation and block identification. The method [7] uses edge information to extract textual blocks

profile data, words are separated from the headings as shown in fig 7.



Fig 2 Heading and column text separated by white pixels

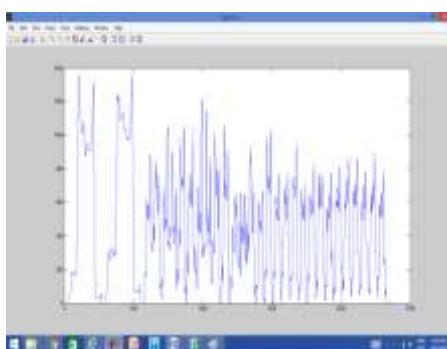
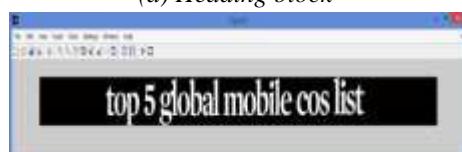


Fig. 3 Horizontal projection profile



(a) Heading block



(b) Heading 2 block

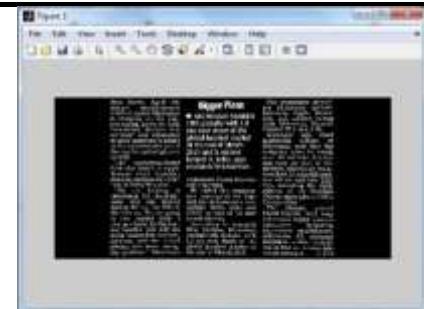
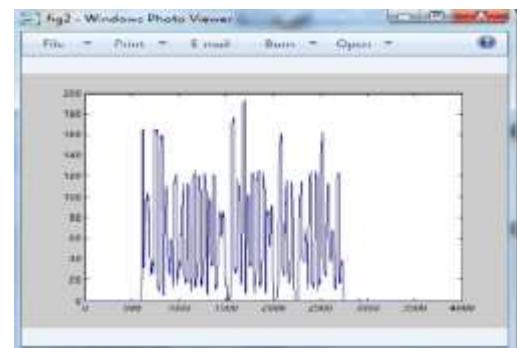


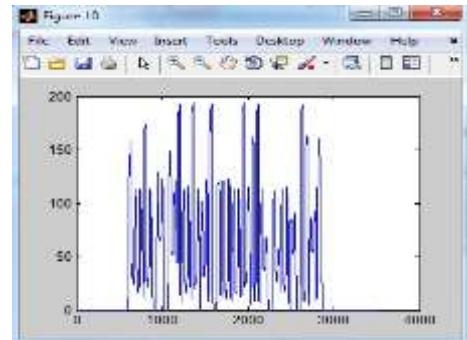
Fig 4 (c) Column Block

Micromax|plans|to|enter

Fig 5: words in the heading seperated by block of black pixels represented by white strip



(a)



(b)

Fig.6(a): Vertical projection profile of the heading1(b)
 Heading2

Micromax|enter|plans|to

Fig.7: segmented words from heading1

3.3 Separating Columns from the Document: After the headers get separated from the images. The columns are separated, for this we use the width of the maximum occurring black run which separates the columns as shown

in the Fig 8. It can be understood that the columns can occur only in those areas where the black spaces occur in large vertical blocks. We find the width of the black run using vertical projection profile as shown in the Fig 9.

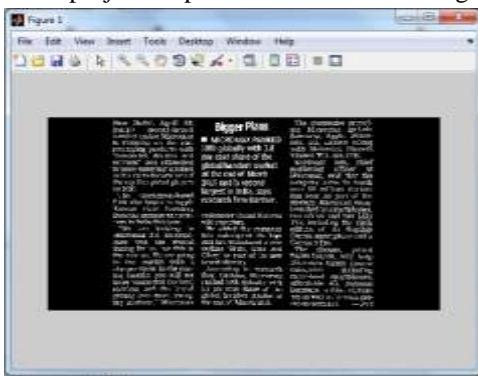


Fig 8: Columns separated by black run

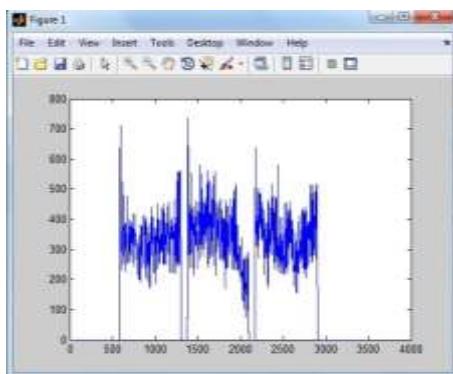


Fig. 9: Vertical projection profile of the columns

3.4 Separating images and paragraphs from the column:
 In this step, we differentiate between text and images present in images. We retain only those runs of black pixels of the input image where the width of the black run is greater than or equal to twice the maximum occurring black run which is found empirically. We then use the connected component algorithm to find the height and width of these components. The components whose height is greater than a fixed threshold of 300 pixels can be said to be an image and hence removed from the document. We also consider the fact that if height is greater than a components width we call it an image and hence eliminate it from the document. We scan horizontally from each of the vertical lines to find continuous black pixel rows. We only consider those rows of black pixels where it can go horizontally till to end of the column using horizontal projection profile of the column as show in Fig 11; this is the threshold for segmenting lines from the columns as shown in the Fig 10.

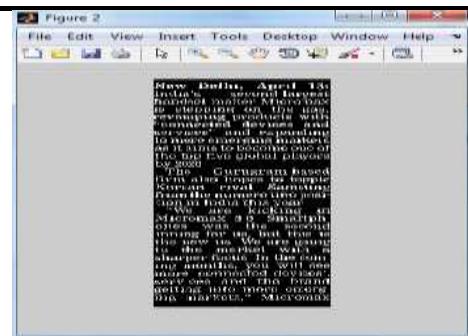


Fig 10: Text in the column

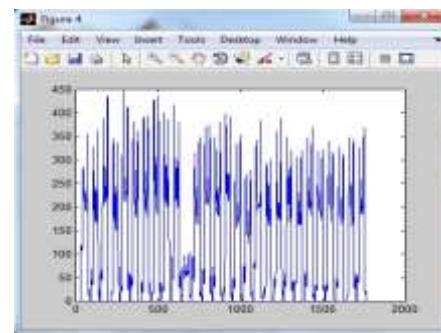


Fig 11: Horizontal projection profile

Separating words from the lines of the column: We use same method as mentioned in the first step. Using vertical projection profiles words from the lines of text are separated.

IV. RESULT AND DISCUSSION

To corroborate the efficiency and effectiveness of the proposed method, we have conducted extensive experimentation with large number of images. The images are obtained by scanning large number of English daily newspapers. Some of the sample outputs are shown below.

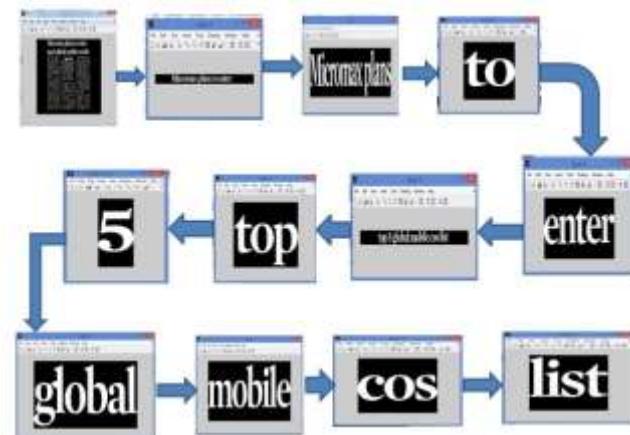


Fig.12: out of proposed method.

The proposed method also handles large number of columns and multifont documents also. The Table 1 shows our testing results for 20 magazine pages.

Table I.: Result for layout analysis

No of Pages	No of Blocks	Wrongly Segmented blocks	Wrongly merged block
25	200	20	10

The Fig 12 shows that the algorithm can accurately identify textual regions on english news paper document. These segmented blocks can be passed on as input to an OCR system.

V. CONCLUSION

In this paper, we presented an efficient algorithm for segmenting unstructured document images. For the purpose of evaluating the proposed method, we have conducted experiments on the English newspaper documents. We tested this algorithm on variety of documents from different newspapers with different page layouts. From the results of the proposed method, it is evident that the proposed method handles the complex and most challenging cases. The result also shows that, the proposed method is efficient and works in hierarchical form.

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